

CLAIMS:

1. An internal combustion engine, comprising:
 - a reciprocable piston;
 - a combustion chamber disposed on a first side of the piston;
 - 5 a crankcase disposed on a second side of the piston opposite to the first side;
 - a valve operating system comprising:
 - a cam;
 - an engine valve movable in response to movement of the cam; and
 - a centrifugally-responsive vacuum release mechanism disposed adjacent the cam,
- 10 wherein the valve is at least partially opened in response to movement of the centrifugally-responsive vacuum release mechanism, while the piston is moving toward the crankcase and away from the combustion chamber.
2. The engine of claim 1, wherein the vacuum release mechanism is pivotably attached to the cam to pivot between an engaged position and a disengaged position.
- 15 3. The engine of claim 2, wherein the vacuum release mechanism includes:
 - an engaging portion having a cam surface that engages a cam follower when the vacuum release mechanism is in the engaged position; and
 - 20 a flyweight portion having sufficient mass to move the cam surface in response to engine speed.
4. The engine of claim 3, wherein the vacuum release mechanism pivots about a pivot axis disposed between the engaging portion and the flyweight portion.
- 25 5. The engine of claim 3, wherein the flyweight portion has a mass that is greater than the mass of the engaging portion.
- 30 6. The engine of claim 3, wherein the engaging portion extends beyond the cam in a radial direction when the vacuum release mechanism is in the engaged position.
7. The engine of claim 3, wherein the cam surface is arc-shaped.

8. The engine of claim 3, wherein the cam surface is disposed near an end of the engaging portion opposite the bridging portion.

9. The engine of claim 1, wherein the vacuum release mechanism is
5 substantially L-shaped.

10. The engine of claim 1, further comprising a slot formed in the cam, wherein the vacuum release mechanism is disposed within the slot, and the slot is partially defined by a back surface that bears load forces imparted on the vacuum release mechanism by a
10 cam follower.

11. The engine of claim 1, wherein the vacuum release mechanism includes:
a beam having a cam surface that engages a cam follower at engine starting speeds;
and
15 a blocking member, movable between an engaged position and a disengaged position, that engages the beam at engine starting speeds.

12. The engine of claim 11, wherein the beam is cantilevered.

20 13. The engine of claim 11, wherein the blocking member comprises a tab disposed between the beam and a cam shaft when the blocking member is in the engaged position.

14. The engine of claim 11, wherein the blocking member is pivotably coupled
25 to a cam shaft.

15. The engine of claim 11, wherein the blocking member prevents a cam follower from fully deflecting the beam when the blocking member is in the engaged position.
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16. The engine of claim 11, wherein the vacuum release mechanism is disposed at a position adjacent the cam such that the cam surface may engage a cam follower while the piston is moving toward the crankcase and away from the combustion chamber.

17. The engine of claim 11, wherein the cam surface separates the cam follower from the cam when the blocking member is in the engaged position.

18. The engine of claim 11, wherein a spring biases the blocking member 5 toward the engaged position.

19. The engine of claim 11, wherein the blocking member is in the engaged position when the engine is operating at starting speeds.

10 20. The engine of claim 11, wherein the blocking member moves to the disengaged position when the engine reaches normal operating speeds.

21. The engine of claim 11, wherein a cam follower deflects the beam when the blocking member is in the disengaged position.

15 22. The engine of claim 11, wherein the beam includes a bracket disposed at an end of the beam opposite the cam surface.

23. The engine of claim 22, wherein a gear is interconnected to the cam shaft, 20 and the bracket is interconnected to the gear.

24. The engine of claim 23, wherein at least one melted nub is used to interconnect the bracket to the gear.

25 25. The engine of claim 1, further comprising:
a cam shaft interconnected to the cam;
a gear interconnected to the cam shaft; and
a yoke pivotably coupled to the gear, wherein the centrifugally-responsive vacuum release mechanism is interconnected to the yoke.

30 26. The engine of claim 25, wherein the yoke is pivotable between an engaged position and a disengaged position.

27. The engine of claim 26, wherein the vacuum release mechanism includes a tab that extends outward from the yoke, and the vacuum release mechanism engages a cam follower when the yoke is in the engaged position.

5 28. The engine of claim 26 wherein the vacuum release mechanism extends beyond the cam when the yoke is in the engaged position.

29. The engine of claim 26, wherein the vacuum release mechanism separates a cam follower from the cam when the yoke is in the engaged position.

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30. The engine of claim 26, wherein the yoke includes a centrifugally-responsive compression release member.

15 31. The engine of claim 30, wherein the compression release member engages a cam follower, and separates the cam follower from the cam when the yoke is in the engaged position.

32. The engine of claim 25, wherein the yoke is substantially U-shaped and includes:

20 a tab portion near the curved, closed end of the U-shaped yoke; and

a flyweight portion near the near the open end of the yoke, the flyweight portion having sufficient mass to move the yoke in response to engine speed.

25 33. The engine of claim 32, wherein the yoke pivots about a pivot axis disposed between the tab portion and the flyweight portion.

34. The engine of claim 32, wherein the yoke at least partially surrounds the cam shaft.

30 35. The engine of claim 25, wherein the yoke is substantially U-shaped and includes a curved closed end and an open end, and the vacuum release mechanism includes a bulge that extends outward from the closed end.

36. The engine of claim 35, wherein the bulge of the vacuum release mechanism is substantially planar with the closed end.

37. The engine of claim 35, wherein the yoke includes at least two legs that 5 extend between the closed end and the open end, and each leg has a recess.

38. The engine of claim 37, wherein the recesses are U-shaped.

39. The engine of claim 37, further comprising a pin retaining the yoke to the 10 gear, the pin having a middle portion extending through the recesses, and two end portions extending into apertures in the gear.

40. The engine of claim 39, wherein the pin is at least partially disposed in the recess and the yoke pivots about the pin.

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41. The engine of claim 39, wherein the pin is C-shaped.

42. The engine of claim 39, wherein the apertures extend in the axial direction of the gear.

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43. The engine of claim 1, further comprising:
a cam shaft about which the cam rotates; and
a pin that interconnects the vacuum release mechanism to at least one of a cam gear and a cam lobe, wherein the pin is substantially transverse and non-intersecting to the cam 25 shaft.